2001 INDUSTRIAL PARTNERING REPORT

Lawrence Livermore National Laboratory

Contents

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I am delighted to share recent accomplishments from our partnerships with industry. I'd especially like to acknowledge that these successes were made possible by the tremendous dedication and hard work of our partners and employees from throughout the Laboratory.

Our partnerships continue to gain momentum, with this year's results pointing the way to an even brighter future.

- The $250 million Cooperative Research and Development Agreement (CRADA) between Lawrence Livermore, Sandia, Lawrence Berkeley National Laboratories and the EUV Limited Liability Corporation has moved extreme ultraviolet lithography (EUVL) from a position as an unlikely candidate for the multi-billion dollar next-generation lithography process to being recognized as the leading contender.
- The world's most powerful computer, the Advanced Simulation and Computing (ASCI) Program's ASCI White, was installed in 2001 and is now fully operational. The program also moves rapidly toward creating a host of scientific advances required for terascale computing.
- As a sign of success, several of our licensees, including PowerStor® and Vysis (described in this publication), were acquired by Fortune 500 companies.
- *Inc Magazine* recognized another licensee, Cytomation, as one of the nation's 500 fastest growing private companies.
- Annual sales of LLNL's top five licensees have risen sharply from less than $10 million in 1997 to over $60 million in 2001.
- Our total number of executed licenses and CRADAs grew by more than 25% over last year, and licensing revenue increased by 60% in the last two years.
- LLNL technologies and know-how have given birth to more than fifty start-up companies that now employ more than 1,300 people. This employment figure does not include companies that have been sold or merged with others.
- Royalties from LLNL's Micropower Impulse Radar Licenses placed that technology among the University of California's top ten generators of income from licenses.

As we celebrate the year of LLNL's 50th Anniversary, our latest report will show you our current partnerships against a backdrop of our history.

- The first section will take you on a brief historical tour to showcase the significant impact LLNL has had on the private sector over the past 50 years.
- The "Partnering Today" section, the bulk of our report, begins with the EUVL project, our featured partnership for the year. Next just a few of our successful technology transfer projects are highlighted. Then, three examples are used to illustrate the essential role industry partnerships play in some of our major programs. The statistics summary at the end of the section illustrates key aspects of our program.
- Our publication concludes with my thoughts about the exciting potential ahead.

I hope that you will share my enthusiasm about this slice of our Laboratory's history, the emerging successes of our current partnerships, and the promise of the future.

Karena McKinley

Director
Industrial Partnerships
and Commercialization
LLNL

A Look Back: LLNL's Impact on the Private Sector

Lawrence Livermore National Laboratory's (LLNL) impact on the private sector is felt in many ways, some quite apparent and others often unrecognized. Our very brief historical tour highlights three ways in which LLNL has made significant contributions to U.S. industry over its 50-year history. Technology innovation required to advance Laboratory missions has influenced the direction of entire industry sectors such as supercomputers, laser optics and biotechnology. LLNL technologies have also been the source of over fifty start-up companies. Finally, Laboratory technologies such as DYNA3D and the telescoping ball bar achieved widespread use in manufacturing processes throughout U.S. industry.

"Scientific achievement is rooted in the past, is cultivated by contemporaries, and flourishes only in a favorable environment. No individual is alone responsible for a single stepping stone along the path of progress."

E. O. Lawrence
Co-Founder
LLNL

Stimulating the Birth of Supercomputers

Relying heavily on computing from its beginnings, LLNL installed one of the first UNIVACs in 1953, just months after the Laboratory opened its gates. Even the best computers of the time, however, were insufficient to perform the simulations needed for LLNL's computationally intensive nuclear weapons codes. The Livermore Automatic Research Computer (LARC) project, a late 1950s collaboration with Remington Rand, is thought by many to represent the beginning of supercomputing.

Working closely with industry leaders such as IBM, Control Data Corporation, and CRAY, LLNL shaped and contributed directly to supercomputer architectures, data management, and storage hardware. Throughout its history, LLNL has strongly influenced the development of the field of high performance computing.

UNIVAC

LARC

This has occurred by establishing new specifications – for example, being the first to require a computer using transistors rather than vacuum tubes; by developing such technology as the first practical time-sharing system; and by developing tools that found private sector homes, such as those used for designing a series of supercomputers for the Navy from scratch (see Valid Logic, page 4).

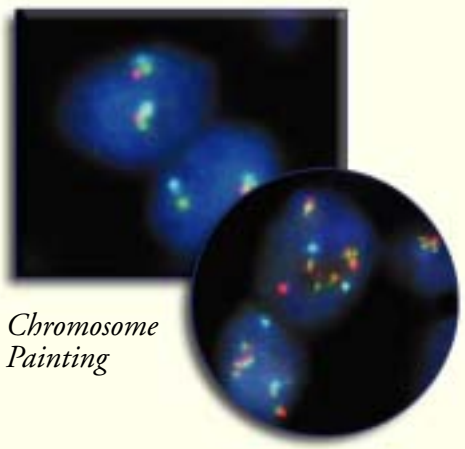
This trend continues now as LLNL collaborates with industry, other Department of Energy/National Nuclear Security Agency (DOE/NNSA) labs, and universities to develop the next-generation supercomputers that will be capable of trillions of operations per second. In 2001, IBM installed ASCI White, the fastest computer in the world, at Livermore. A large array of supporting developments is underway (see page 18).

The Home of Big Lasers

In the early 1970s, the Lab began construction of a series of increasingly large, indeed largest-in-the-world, laser systems. These required precision engineering of laser materials and optics well beyond commercially available products. By transferring LLNL technology and working closely with vendors on new technology development, LLNL has shaped the technology infrastructure of the nation's precision optics industry. The results of LLNL optics R&D include new crystalline lasing materials; large, rapidly grown crystals for optical switches and frequency conversion applications; continuous-pour defect-free laser glass; methods for producing optical surfaces and coatings of extraordinary quality; and optical characterization metrology of unprecedented precision. This work has enabled advances in fields as disparate as semiconductor lithography, astronomy, and high energy density physics. Many of these optical technologies have been integrated into commercial products for precision optics and laser materials. LLNL is also recognized as a world leader in laser technologies, and LLNL's laser technologies are contributing to the growing field of laser manufacturing processes (see Metal Improvement Company, page 12) as well as to new products for medical, communications and defense applications.

National Ignition Facility (NIF)
(see page 19)

Shaping the Development of Biotechnology



Chromosome Painting

Growing out of its groundbreaking work on genetic damage caused by radiation, LLNL's biology program played a key role in the birth of human genome mapping. At a seminal meeting called by DOE in Alta, Utah in 1984 to explore the feasibility of using DNA technologies including sequencing to quantify mutations passed from parent to child, the first formal estimates were made of what would be required to actually map the human genome. In 1987, based on a joint planning effort with LLNL and the Los Alamos National Laboratory (LANL), the DOE initiated the Human Genome Project to apply the large-scale science talents of its laboratories to the giant challenge of mapping and sequencing the human genome. Joined by the National Institutes of Health soon after and, more recently, by the private sector, this effort has shaped the entire modern field of biotechnology and has laid the foundation for the exciting field of targeted drug development as well as advances in the detection of chemical and biological pathogens and an array of other applications. LLNL also made important contributions to the critical underlying fields of flow cytometry, chromosome painting, chromosome mapping strategies, and the establishment of chromosome-specific gene libraries. Specific inventions are beginning to form the basis of some important commercial endeavors (see Vysis and Cytomation, pages 8, 10). In 1996, DOE chartered LLNL, LANL, and the Lawrence Berkeley National Laboratory (LBNL) to work together in the Joint Genome Institute to further enhance its focus on this important work.

"LLNL and Lowell Wood are the godfathers of the $3 billion per year EDA industry. In the mid-70s, under Lowell's direction, LLNL supported a bold experiment in computer architecture and computer design technology called the S-1 Project. SCALD was a byproduct of that effort and turned out key in the formation of the EDA industry."

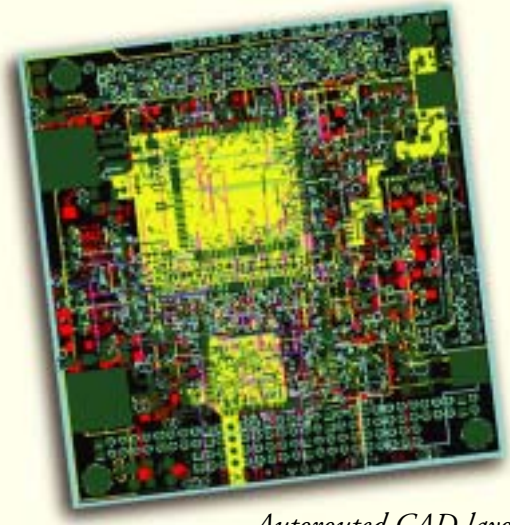
Curt Widdoes
President & CEO
0-In Design Automation

Therma-Wave: A Spin-Off Success

In 1982 LLNL employees Allan Rosencwaig and David Willenborg formed Therma-Wave. Soon joined by John Opsal, also of LLNL, their first product was based on advances in photoacoustic spectroscopy developed to meet the stringent requirements of non-destructive inspection of subsurface defects of nuclear weapon components. LLNL scientist Lee Smith later joined them. Drawing from experience from the Laboratory's laser program, Therma-Wave went on to develop commercial products that revolutionized ion implant measurement and film thickness measurement. By allowing semiconductor manufacturers to launch next-generation products without many of the process control uncertainties they experienced in the past, these products have made possible major advances in the manufacturing process. The company is now a worldwide leader in process control metrology systems for semiconductor manufacturing. Therma-Wave completed a successful initial public offering in February 2000 and by 2001 had grown to employ 630 people and generate about $200 million annual revenues.

Therma-Wave's Opti-Probe® thin-film measurement system

Valid Logic: Another Start-Up Success



Autorouted CAD layout

In 1981, LLNL scientists Curt Widdoes and Tom McWilliams founded Valid Logic Systems, which, along with Daisy Systems and Mentor Graphics, is often credited with pioneering the electronic design automation (EDA) industry. Valid Logic Systems' initial products were based on the Structured Computer-Aided Logic Design (SCALD) software, developed at LLNL in the mid-70s. SCALD allowed almost completely automated design, manufacturing and testing of high performance digital circuits, drastically reducing the time and cost to design computers and digital circuits. Valid Logic reached a market capitalization of $250 million, considered a huge value for a start-up company in the 1980s, and was later bought by Cadence Design Systems. The significance of the SCALD technology was acknowledged by the respected professional organization IEEE Computer Society, which, in 1984, granted Widdoes and McWilliams the coveted W. Wallace McDowell Award, the second time this award was ever given for government-sponsored research.

Telescoping Magnetic Ball Bar

When Jim Bryan invented the telescoping magnetic ball bar while struggling to achieve the extreme precision required for nuclear weapons components, he gave birth to an innovative instrument for testing machine-tool performance quickly and accurately. Renishaw, Inc. licensed this LLNL technology from the DOE in 1986 to build and sell a commercial version of the device and rapidly consolidated its worldwide leadership position. The technology has changed the way machines are tested around the world. Having been written into national standards of the American Society of Mechanical Engineers for calibration of several numerically controlled machines, this device has been used to test literally billions of dollars worth of machine tools over the last decade. It is used extensively by large manufacturers such as Boeing, Caterpillar, GE and Pratt & Whitney. Jim Bryan was recognized as one of the six Heroes of U.S. Manufacturing for 2000 by *Fortune* magazine.

Jim Bryan

> *"This technology has impacted companies from the small job shops to large multi-national companies; from people who make refrigerators to those who make airplanes to those who make cars."*
>
> Leo Somerville
> *President*
> *Renishaw, Inc.*
> *(Commenting on the Telescoping Ball Bar)*

DYNA3D

Crash simulation using DYNA3D

Thanks to an LLNL software code, the coffers of American industry are richer by $350 million a year, according to a January 1993 study by two marketing consultants. The DYNA3D ("Dynamics in 3 Dimensions") computer program was developed in the 1970s to model the structural behavior of weapons systems. It was later broadly released to research institutions and industrial companies and gained widespread acceptance as the standard for dynamic modeling. The list of companies that have used DYNA3D reads like a "Who's Who" of American industry: GE, General Motors, Chrysler, Boeing, Alcoa, General Atomics, FMC Corp, Lockheed, and more. The 1993 study found that DYNA3D generates large savings for U.S. industry by allowing speedier release of products to market and enabling savings in costly physical tests such as automobile crash tests.

The Pinnacle Of Inventions

This intensive activity has given birth to remarkable technologies and commercial applications and it has not gone unnoticed. LLNL has received 85 R&D 100 Awards since 1978, representing almost 4% of all the awards given out globally by *R&D* magazine. In 2001, LLNL was awarded R&D 100 awards for Manufacturing Laser Glass by Continuous Melting, the Gene Recovery Microdissection Process, and the Lasershot Marking System. Since 1985, LLNL has also received 25 Federal Laboratory Consortium (FLC) awards for excellence in technology transfer.

In each edition of our LLNL Industrial Partnering Report we select one partnership, initiative, or technology that is having a major influence on our laboratory, our partners, and/or the community. The extreme ultraviolet lithography Cooperative Research and Development Agreement (CRADA) does all three.

Extreme Ultraviolet Lithography

> *"EUVL represents both a partnership and technical triumph."*
>
> C. Bruce Tarter
> *Former Director*
> *LLNL*

THE TECHNICAL CHALLENGE

By adding more and more transistors on a single chip, computing capability has experienced enormous growth during the last decade. For quite some time, however, it has been clear that optical lithography technology used to etch features on silicon wafers will soon run into fundamental physical limits. Simply put, continuing with Moore's Law – the doubling of power of electronic chips every 18 months, which has become the industry standard for advancement and success – requires development of a next-generation lithography (NGL) system.

In the early 1990s, research was being conducted on four NGL approaches. Because of the enormous expense and complexity of the chip fabrication process, the semiconductor industry recognized the imperative of agreeing on a single standard that all competitors could use.

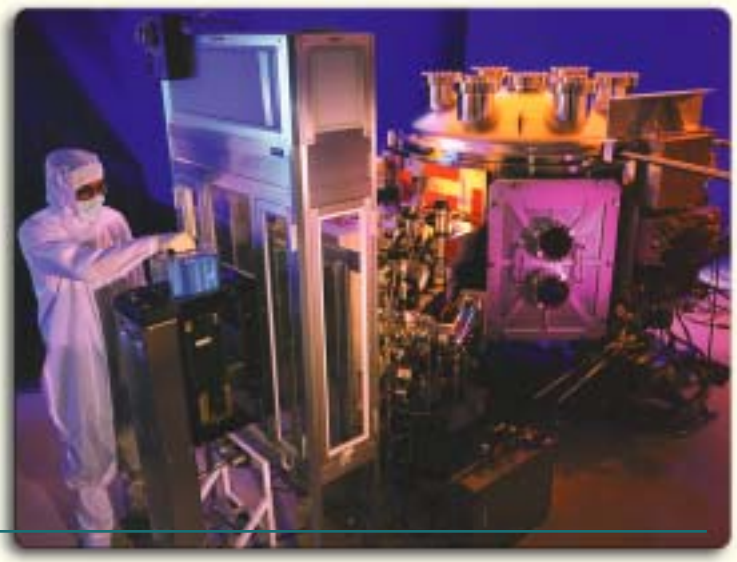
GOVERNMENT AND INDUSTRY PARTNERING FOR NEXT GENERATION LITHOGRAPHY TOOL

In the early 1990s researchers from LLNL's Laser Program began work on extreme ultraviolet lithography (EUVL). By leveraging Laboratory discretionary research money and DOE Technology Transfer Initiative funds, the research had demonstrated considerable promise by the mid-1990s. In 1997, the EUV Limited Liability Company (LLC) was begun by Intel Corp. to accelerate development of the technology as a NGL candidate.

Today, LLC members include industry leaders Intel, Motorola, Advanced Micro Devices, Micron Technology, Infineon Technologies and International Business Machines. The CRADA has a current budget of $250 million over five years funded by the industrial partners, and a workforce of about 150. This large-scale, highly multi-disciplinary project capitalizes on the unique niche national laboratories occupy between the basic research world of universities and the highly applied research conducted by industry.

VIRTUAL NATIONAL LABORATORY FORMED – A UNIQUE CONCEPT

In 1997, Lawrence Livermore, Sandia, Lawrence Berkeley National Laboratories (LLNL, SNL, and LBNL) formed a Virtual National Laboratory to work with both the EUV LLC and its suppliers as part of the largest-ever cooperative R&D project at DOE laboratories. The concept of a VNL was unique in the DOE system and has allowed the EUV LLC to work predominantly with a single entity representing the three separate laboratories. Efforts of the VNL have focused on integrating the necessary technologies into an engineering test stand that will function as a prototype EUVL system. LLNL leads the efforts in the test stand's optical systems and components, thin films, masks, and nanometer metrology.

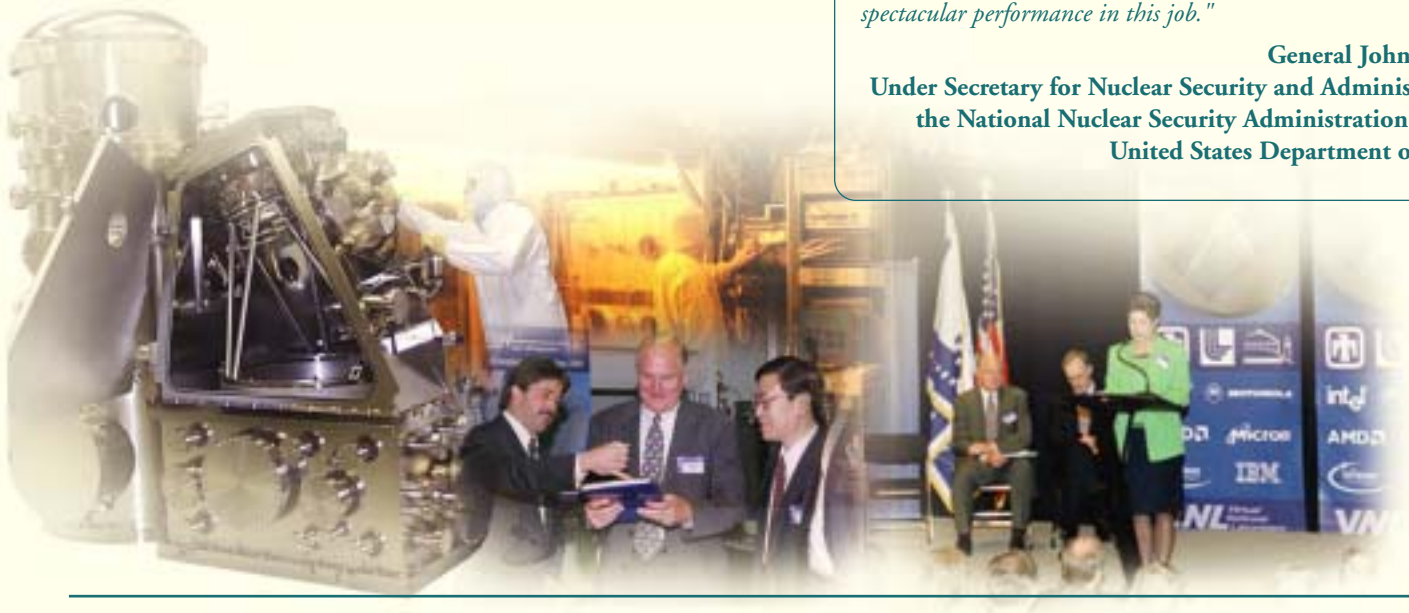


"FIRST LIGHT" ACHIEVED – EUVL PROTOTYPE PROVING TECHNOLOGY WORKS

In April 2001, "first light" was achieved at the EUVL Engineering Test Stand. After five years of extraordinary technical advances, the first full-scale prototype lithography system, the Engineering Test Stand, was completed. For the first time it was possible to print patterns onto silicon wafers with features as small as 0.70 nanometers, or about a thousandth the width of a human hair. The EUVL process has moved from being an unlikely contender in the field of four competing NGL approaches to gaining recognition by industry association International Sematech as a likely winner in the competition.

NEXT STEP TOWARD COMMERCIALIZATION

The next step for commercialization of EUVL technology is for the EUV LLC to transfer the technology to lithography equipment manufacturers to develop beta and production tools. The beta tools are anticipated to be available in 2005. Capital cost alone to implement the technology through semiconductor fabrication plants will be several billion dollars.



Highlights from the EUVL "First Light" Milestone Celebration (April 2001)

"We were impressed by how the labs would come up with ideas or solutions that seemed sometimes literally magical – it seemed like things that no one imagined could be done were done. And I think that it is because of the great depth and diversity of skills and resources throughout all the national laboratories – it's truly what makes it a national treasure."

Sunlin Chou
Senior Vice President for Technology and Manufacturing
Intel Corp.
EUV LLC Chairman

"This is just the type of work that we want to have in national laboratories, and what national laboratories should engage in. It involves a strategic industry critical to the United States. It provides really broad challenges - broad challenges that stretch our scientists, that stretch our technology, and that stretch our engineers to really bring forth their very best talents and most innovative ideas. Sandia, Lawrence Livermore, and Lawrence Berkeley have had just spectacular performance in this job."

General John Gordon
Under Secretary for Nuclear Security and Administrator of the National Nuclear Security Administration (NNSA)
United States Department of Energy

"We're taking the best scientists and engineers in the national laboratories, the best scientists and engineers in our industry and the best scientists and engineers in the equipment supplier industry, and putting all of their ideas to work to solve a common problem…. The coordination we have shown is heart-warming. It's just phenomenal."

Craig Barrett
CEO
Intel Corp.

Although much has been written about the quickening pace of the concept-to-product cycle, technology transfer projects usually require a number of years to show strong results. Recently, a growing number of our 80-plus licensees have begun reaching market with their products. In this section we highlight a few of those along with a sample of our successful CRADA partnerships.

Vysis: Identifying DNA Abnormalities

"This technology allows us to identify genetic changes important to the behavior of tumors, but otherwise not apparent. The idea is that one treatment is not best for every patient. It tells us who needs what kind of treatment. It individualizes treatment to the needs of the patient's tumors."

Dr. Thomas Look
St. Jude's Children's Research Hospital
Memphis, TN

FAST-GROWING COMMERCIAL SUCCESS

Beginning in the mid-1970s, LLNL discovered and developed the flow cytometric ability to identify and sort chromosomes. Eventually this led to the full set of chromosome-specific human DNA libraries. With the associated development of practical methods to block the hybridization of repetitive DNA, such libraries provided the material to specifically stain each of the 24 different human chromosomes. Chromosome painting, credited to Joe Gray and Dan Pinkel of LLNL, has revolutionized cytogenetics (the study of chromosomes) and its application to human exposure and disease.

VYSIS PRODUCTS HAVE FDA APPROVAL

Licensed exclusively to Vysis, a genomic disease management company, LLNL's chromosome painting technology is enabling the evaluation and management of certain genetic diseases, potentially allowing treatments customized to each patient's specific needs.

Since incorporation in 1991, Vysis has been a commercialization success story. Six Vysis products have been either cleared or approved by the FDA, and Vysis was the first genomic company to receive ISO 9001 certification (1996) and to turn a profit (2000). One of its products, a breast cancer diagnostic kit, offers great hope for patients and doctors in treating a disease that afflicts over 1.7 million Americans today. Seeing the promise of this young company, industry leader Abbott Laboratories acquired Vysis in 2001.

Today, the Vysis distribution network covers 51 countries, including Europe, Africa, and the U.S. Its economical fluorescence in situ hybridization (FISH) technology has the potential to enable medical clinicians to diagnose disease more quickly and accurately than with current methods, and determine the most appropriate treatment.

WHAT DOES THE FUTURE HOLD?

More than 10,000 scientific articles have been written about FISH probes, and FISH tests are being used by hundreds of laboratories worldwide.

For patients and physicians the technology produces a new, powerful breed of diagnostics. It will potentially allow physicians to know who is at risk for disease, identify molecular changes that indicate diseases such as cancer before symptoms appear, and potentially determine the treatment for each patient, thereby minimizing adverse drug reactions.

For the health care industry as a whole, some experts predict that the infant genetic diagnostic market today will swell to over $5 billion in the next decade. Unlike other diagnostic technologies, patent protection on genetic diagnostics will enable higher profit margins for the pioneers in this new frontier. There is no doubt that medicine will owe a great deal to this exciting biomedical breakthrough.

Cepheid: Miniaturizing Bio-Analytical Systems

CEPHEID'S CORE TECHNOLOGY LICENSED FROM LLNL

Cepheid, a Sunnyvale, California start-up company whose core products are based on LLNL technology, has been making great strides. After winning an R&D 100 Award for one of the most important new technology products of 1998, the company went public in June 2000 with a $35 million IPO.

LLNL-licensed technology is the basis for a family of products that provides researchers with quantitative DNA analysis with results in less than 30 minutes. One of Cepheid's Smart Cycler® products is a portable unit that allows customers to obtain bio-analytical results when and where they are needed. A next generation product will accept raw biological specimens, significantly simplifying the process of obtaining field-based DNA measurements.

A BROAD CUSTOMER BASE

Although Cepheid has recently received much attention for its field-ready DNA testing systems for rapid detection of deadly bio-threat agents such as anthrax (see "Homeland Security", pages 16, 17), its products have many other applications. The wide range of customers who benefit from these products includes physicians, researchers and diagnostics test developers, food plant managers, crop managers and military bio-defense and medical personnel.

"The potential of Cepheid's technology is to enable physicians in office and clinical environments to perform real-time, point-of-care diagnostics eliminating the 5-7 day wait now required to obtain definitive results."

Dr. Tony Godfrey
Assistant Professor of Surgery and Human Genetics
University of Pittsburgh Cancer Institute

"Smart Cycler's … three advantages over "standard" PCR are: the system is quantitative, it is more rapid, and the potential for contamination is greatly reduced …"

Dr. Beverly Rogers
Associate Professor of Pathology
Laboratory for Molecular Diagnostics
University of Texas Southwestern Medical School

"In one application, the Smart Cycler has paid for itself 10-fold in 6 months. We are very pleased with the Smart Cycler's performance and plan to expand our use in the near future."

Thomas Romick, Ph.D.
Group Manager
ConAgra Grocer Products Company

"The adaptation of LLNL technology, which is the basis of the Smart Cycler and GeneXpert® systems, has allowed Cepheid to revolutionize DNA-based testing."

Thomas L. Gutshall
Chairman
Cepheid

Cepheid's GeneXpert system

Cytomation: High Performance Cell Sorting

"We saw it as a great way to do business without starting from scratch."

Nigel Ferrey
CEO
Cytomation
(Regarding LLNL Relationship)

FAST-GROWING COMMERCIAL SUCCESS

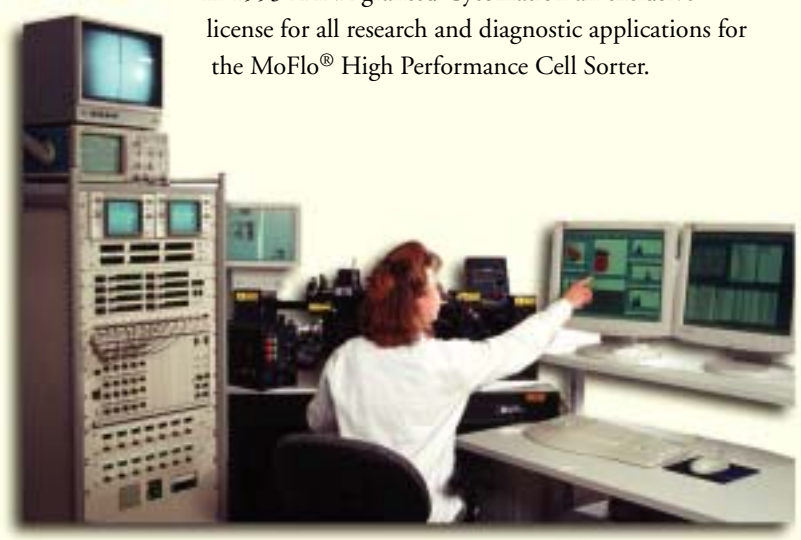
Seven years ago, LLNL licensee Cytomation employed 18 workers and posted $1.8 million in revenue. By the end of 2001 Cytomation had 150 people on its payroll and $27 million in revenue, earning it a spot on *Inc Magazine*'s list of the country's 500 fastest growing privately held businesses.

To date, over 250 of its instruments have been placed in universities, research hospitals and pharmaceutical companies in the U.S., Canada, Europe, Australia, Japan and Argentina. The future continues to look very bright for Cytomation.

THE RIGHT CALL

In 1992 Cytomation became interested in LLNL when principals of the company read an article in *Genetic Engineering News* about a Lab scientist who had developed a high-speed cell sorter and was lamenting the lack of commercial interest. Cytomation made a call inquiring about the technology, a meeting was set to discuss partnership opportunities, and a great success story began.

In 1993 LLNL granted Cytomation an exclusive license for all research and diagnostic applications for the MoFlo® High Performance Cell Sorter.



MoFlo® High Performance Cell Sorter

BROAD APPLICATIONS IMPROVING DAILY LIFE

Cytomation has created a modular, custom-configured, flow cytometry platform that uses laser optics, fluidics, electronics, robotics and software to analyze and sort up to 70,000 single cells a second. The product is used for biomedical research, drug discovery, cancer and HIV research, stem cell research, gene therapy, DNA diagnostics, livestock sex selection and other applications.

"The original design philosophy underpinning MoFlo®, with its open architecture, allowed Cytomation to develop a wide product range enabling applications in biomedical research heretofore not possible."

Nigel Ferrey
President and CEO
Cytomation

"Cytomation made this instrument (MoFlo®) commercially available, widening its use from biomedical research into areas such as agriculture, marine biology and the chemical industry. Theorized applications became mainstream, such as stem cell enrichment, purification of antigen-specific cytotoxic cells, mammalian gender-selection by sperm sorting and enzyme discovery using thermophilic organisms. The use of this technology will continue to have a huge impact on scientific discovery as it has in the past."

Peter Lopez
The Aaron Diamond AIDS Research Center

NOMOS: Radiation Therapy Solutions

PEREGRINE™ IS FDA APPROVED AND AVAILABLE IN CLINICS IN THE UNITED STATES AND EUROPE

NOMOS licensed PEREGRINE, a new approach to planning radiation therapy, from LLNL in July 1999. The FDA granted clearance to NOMOS Corporation in the Fall of 2000 to make PEREGRINE available to clinics across the country. PEREGRINE is currently available to patients in a number of clinics in the U.S. and Europe, and its use is growing rapidly.

NOMOS Corporation, LLNL's licensee in Sewickley, Pennsylvania, is a leader in advanced radiation therapy solutions in the fight against cancer. PEREGRINE is based on decades of research by Livermore in radiation physics and uses Monte Carlo statistical techniques to predict accurately the radiation dose to tumors and other structures within the patient's body during a radiation treatment. With PEREGRINE, doctors and clinicians can know precisely the dose amounts being delivered both to a tumor and to surrounding sensitive tissue, even in the most complex, multi-beam treatments.

This represents a vast improvement over traditional radiation treatment planning systems that have only been able to specify the theoretical calculation accuracy of their dose plan because they lacked information about the interaction of the radiation beams with a patient's body.

MORE ACCURATE TREATMENT IMPROVES QUALITY OF LIFE

Because of the highly accurate dose calculations available with PEREGRINE, radiation oncologists and clinicians can now target a tumor with an escalated dose of radiation, while simultaneously minimizing the problem of frequently severe burning of surrounding healthy tissue. The benefits to the patient are significant.

John Manzetti
President and CEO
NOMOS Corporation

"NOMOS Corporation has worked hard to productize this technology and is making it available to all hospitals and clinics worldwide as we strive to transform the treatment of cancer as well as the lives of cancer patients around the world."

"Melding the research of LLNL and the DOE with the technical expertise of a medical technology company has produced a dynamic new weapon in our cancer fighting arsenal. Years of nuclear weapons research have been used to create technology that will save lives in the years ahead."

NOMOS Corporation

Metal Improvement Company: Laser Peening and Marking

"Our collaboration with LLNL on the Laser Peening technology has exceeded our every expectation. With their help, we were able to bring this exciting technology to the point of commercialization. Our company is well positioned now to bring the benefits of Laser Peening to our worldwide metal working industry customers. We look forward to identifying future manufacturing technologies to collaborate on with LLNL."

Gerald Nachman
President & CEO
Metal Improvement Co., Inc.

METALWORKING AND LASERS

Discovered in the early 1970s, laser peening remained only a laboratory technical curiosity until GE used it to solve a critical problem on the B1 bomber turbine engine. However, the slow laser firing rate hampered development of significant commercial applications. In 1997 Metal Improvement Company (MIC), an established provider of conventional shot peening services to industry, entered into a CRADA with the Laboratory to develop a commercially viable laser peening process based on a high-energy and high-pulse rate LLNL laser. The collaboration was successful, and now metals can be laser peened effectively and economically, resulting in stronger metals. This process is expected to extend the service lifetime of some metal parts like aircraft engine fan blades by a factor of 3 to 5.

Pushing their collaboration a giant step further, LLNL and MIC researchers developed the Lasershot Marking System to imprint permanent, high-resolution identification marks on safety-critical parts and Laser Peen Forming, which can open a new frontier in net shape manufacturing. These remarkable achievements have been recognized by receiving coveted R&D 100 Awards for two of the LLNL/MIC discoveries.

In 2001, MIC finalized a contract with a major aerospace company for laser peening and broke ground for a new facility in Livermore. Laser peening and laser marking applications are being explored for aviation parts, medical devices (such as hip and knee implants), and automotive components.

SPINBACK TO DOE

Interestingly, several "spinback" applications for laser peening have surfaced related to DOE's programs for stockpile stewardship, fuel-efficient vehicles, and long-term nuclear storage. This technology has been used on NASA's space shuttle since 2001. MIC estimates that laser peening automobile frames could potentially save the U.S. 285 million liters of gas annually.

As LLNL's Lloyd Hackel states, *"What we have come to is an active CRADA that's working to field the technology for specific industries and spinning it back with important benefits to Laboratory and DOE work."*

Laser peening of engine fan blades for U.S. Air Force F-16 fighter jets eliminates crack propagation along the leading edge. Peening prevents blade failure extending service lifetime and reliability.

PowerStor®: Supercapacitor with Truly Unique Characteristics

UNIQUE QUALITIES DISCOVERED DURING "BRILLIANT PEBBLES"

In the 1980s, LLNL scientists worked on a power source for small, lightweight, low-cost space-based missile interceptors called "Brilliant Pebbles." In a technological breakthrough, they used the Lab's carbon aerogels to develop a unique ultra-high capacitance device. In 1993, the resulting supercapacitor technology was licensed to PolyStor Corporation, a company founded by former LLNL employees. In 1998, PolyStor spun off PowerStor® as a separate company in Dublin, California to manufacture and market supercapacitors.

FORTUNE 500 COMPANY PURCHASES POWERSTOR®

PowerStor®'s aerogel-based product is a truly unique line of supercapacitors whose breakthrough resistance makes them ideal for pulse-power and electronic circuitry applications that other supercapacitors cannot support. With many advantages over both standard capacitors and traditional batteries, aerogel supercapacitors are capable of storing hundreds of times more charge than conventional capacitors. When used in conjunction with a battery, they can extend battery life and minimize battery size, thus increasing available energy by providing high peak power when necessary. PowerStor® has grown quickly with an impressive array of customers and applications for its products.

In 2001, Cooper Electronic Technologies, a Fortune 500 company, acquired PowerStor® to supply a growing target market uniquely positioned between a $15+billion battery market and a $9 billion capacitor market.

POWERING THE NEXT GENERATION OF PORTABLE AND WIRELESS PRODUCTS

Aerogel supercapacitors have received wide acceptance in the market and are used by major Fortune 500 companies in power applications that include main power, hybrid battery packs, hold-up power and pulse power in a variety of wireless communication devices, mobile computing equipment, electronic toys and games, industrial actuators and power conversion systems. Aerogel ultracapacitors are used in many wireless and portable applications such as wireless data transmitters, handheld computing devices, pagers, and radios. They also make possible medical portable infusion pumps and are being evaluated for automobile power and safety equipment.

PowerStor® products

"PowerStor®'s Aerogel Supercapacitors … provide the extra power needed for tomorrow's wireless communication, computing, automotive, medical and military applications."

Marc Juzkow
Director of Marketing
Cooper Electronic Technologies

Dynamic Underground Stripping/Hydrous Pyrolysis Oxidation

"The Dynamic Underground Stripping remediation performed at the Solvent Tank Area far exceeded our expectations. The process has literally saved SRS decades in remediation time and associated costs."

James Kupar
Technical Lead
Upper Three Runs Project Team
Bechtel Savannah River, Inc.

A new technique called Dynamic Underground Stripping/Hydrous Pyrolysis Oxidation (DUS/HPO) heats soil and groundwater to remove underground contaminants and destroy them in place, and it does this much faster than any currently available conventional clean-up method.

DUS uses steam heat and pressure to drive contaminants to extraction wells, where they are easily removed from the soil and water. Heat and forced air chemically break down many contaminants in place, converting them into harmless compounds. The associated imaging technology, electrical resistance tomography, allows clean-up operators to monitor and control the heating process in real time.

PROVEN MORE EFFECTIVE AND FASTER

The DUS technology was used to clean-up Southern California Edison's (SCE) pole yard property in Visalia, California where power poles had been treated with creosote, pentachlorophenol and other chemicals for 60 years. In the first nine months of use at Visalia, DUS removed or destroyed an amount of contaminants that would have required more than 1,000 years with the traditional pump-and-treat clean-up method and was also found to be 2,000 times more effective. Environmental experts estimated that this clean-up could cost SCE less than $20 million by completion. In contrast, pump-and-treat was costing more than $1 million annually.

LLNL scientists observing contaminants removed from Visalia site

DUS USE IS GROWING RAPIDLY

At the DOE's Savannah River Site, the DUS system at peak operation removed 1,200 pounds of contaminants daily. It is estimated that DUS extracted material 15 times faster than the original soil vapor extraction method used and 75 times faster than the pump-and-treat configuration that was in operation.

COMMERCIALIZED TECHNOLOGY GARNERS PRESTIGIOUS AWARDS AND PRAISE

LLNL has licensed this powerful technology to three partners: Steamtech Environmental Services, Southern California Edison and Integrated Water Resources.

The U.S. Environmental Protection Agency (EPA) awarded the technology its 1999 Outstanding Remediation Technology Innovation Award.

"Since we completed the Dynamic Underground Stripping Project in June of 2000, we have seen a steady improvement in ground water quality. Most of the ground water monitoring wells are clean, and we seem to be on-schedule to meet our clean-up goals within a year or two."

Randall Weidner
Project Manager
Southern California Edison

"We are exceedingly pleased with the dramatically successful clean-up results that have been achieved at Visalia with this new technology. This advance has the potential to remediate up to one quarter of the nation's Superfund sites."

Bill Richardson
Former Secretary of Energy
United States Department of Energy

www.llnl.gov/dus/dus.html

Endress+Hauser: A Truly Successful Licensee

Endress+Hauser (E+H), headquartered in Reinach, Switzerland, has successfully commercialized LLNL's Micropower Impulse Radar (MIR) technology, with sales exceeding $20 million. MIR was a spin-off from advanced digitizer work performed by inventor Thomas McEwan for LLNL's giant Nova laser. The Nova laser had been built for Livermore's fusion research program.

E+H began its relationship with LLNL in January 1995 based on a small article in a German weekly on the MIR technology breakthrough. E+H immediately formed a development team at the E+H USA facility in Greenwood, Indiana to develop Levelflex, the first E+H measurement system using the MIR technology. E+H was an ideal licensee because of its impressive history in innovation and strong in-house technical talent.

FIRST COMPANY TO RECOGNIZE POTENTIAL OF MIR FOR SOLID LEVEL MEASUREMENT

One of the most promising industrial applications of the MIR technology is its use as a continuous level measurement system using the techniques of guided cable radar. E+H recognized that MIR held high potential for measuring the level of bulk solid materials such as cement, grain, or a variety of other materials. Modern production, handling and storage of bulk solids today are often done in fully automated plants. Thus, high quality requirements of the food industry (e.g., flour, cereals, sugar, coffee) or the chemical industry (e.g., plastic powders and pigments) have to be met. The use of MIR also reduces energy consumption for these and other industries.

With the rise of automated plants, the classic instrumentation used in bulk materials often met its limits. Due to low energy losses even in dusty atmospheres and the possibility to use single wire lines as single probes for the high pull-out forces met in bulk solids, the MIR technology offered the ideal complement to the existing ultrasonic measurement devices.

Levelflex products – Guided level-radar measurement systems using the Time of Flight principles

"The Micropower Impulse Radar portfolio has been licensed extensively for many applications, and Endress+Hauser is our most successful MIR licensee to date."

Karena McKinley
Director
Industrial Partnerships
amd Commercialization
LLNL

Partnering Today: Progammatic Partnerships

Increasingly LLNL's programmatic work is intertwined with that of its industry partners. In the case of much of our Homeland Security work, technologies developed at our Laboratory cannot be broadly used until a private sector partner develops products based on our work. Our ASCI and NIF programs require major technology advances, not only within the Laboratory but from our strategic partners as well, in order to accomplish our mission objectives.

"For years, the national laboratories, including LLNL, were getting ready for things that the rest of us haven't been thinking about. Their contributions after September 11 are a dramatic illustration of the importance of doing research before applications become urgent."

John McTague
Vice President
University of California

Homeland Security

HOMELAND SECURITY IS A DOE / NNSA MISSION

While LLNL has long been involved in R&D related to counterterrorism, the events of September 11 intensified the DOE's effort to bring the scientific horsepower of its national laboratories to bear on the war against terrorism. The anthrax episodes have sensitized government and industry to the very real threat of biological or chemical terrorism.

LABORATORY SCIENTISTS LEND SUPPORT AT GROUND ZERO

In the days immediately following the World Trade Center attack, a DOE aircraft delivered a team of Livermore scientists to New York City to deploy their R&D 100 Award-winning Micropower Impulse Radar (MIR) technology in support of search and rescue efforts at Ground Zero.

The MIR-based remote casualty location and assessment device prototype can be used to detect the slightest of movements. It can track heartbeats and breathing through 20 feet of rubble from distances of up to 60 feet. Although no survivors were rescued after September 12 by any means, the device was successful in penetrating the pile in calibration runs and operating with a zero false alarm rate over six days of rescue operations.

LLNL's MIR technology has been commercialized in other forms by a number of licensees, including Endress+Hauser (featured on page 15).

LLNL INDUSTRIAL PARTNERS MAKE MINIATURIZED DEVICES FOR BIODETECTION

Two companies, Cepheid and Environmental Technologies Group (ETG), have received much publicity in the aftermath of September 11 for products that can identify pathogens in near-real time.

WINTER OLYMPICS AND USAMRIID USE CEPHEID'S PRODUCT

Cepheid Corporation, of Sunnyvale, California (see page 9), is combining micromachining technology with recent advances in biological instrumentation to provide fully integrated, miniaturized systems for biological research and diagnostics.

Cepheid's Smart Cycler® is a portable biodetection system, based on LLNL technology, that provides rapid DNA analysis, with results available in 30 minutes or less. The Biological Aerosol Sentry and Information System (BASIS), developed jointly by Livermore and Los Alamos and deployed at Salt Lake City as part of the overall security strategy for the Winter Olympic Games, uses Smart Cyclers as the heart of its field laboratory.

The U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), in its mission to protect military personnel from biowarfare agents and endemic infectious diseases, has contracted with Cepheid to provide field-ready instrumentation and DNA test kits for rapid detection of anthrax, plague, tularemia, and botulinum toxin.

Cepheid's Smart Cycler® system

DEPARTMENT OF DEFENSE EVALUATING ENVIRONMENTAL TECHNOLOGIES GROUP FOR BIODETECTOR

Environmental Technologies Group (ETG), a sub-licensee of Cepheid and a collaborator with LLNL, is developing a handheld biodetector. This instrument, based on Livermore technology for the Handheld Advanced Nucleic Acid Analyzer (HANAA) is the first truly portable, battery-powered PCR-based biodetector. The Defense Department is evaluating ETG's Bio-Seeq, the next generation HANAA, for its military services.

PROMISING LLNL TECHNOLOGY FOR CHEM/BIO DECONTAMINATION

Civilian first responders have virtually no decontamination methods other than soap and water and perhaps bleach available to them. Livermore has developed a decontamination reagent that is effective against both chemical and biological agents, is environmentally benign, does not damage the surfaces or materials on which it is sprayed, and is easy to use. This reagent, called L-Gel, is a fumed amorphous silica gel. Since it is a gel, it clings to vertical and horizontal surfaces, maximizing contact time with the contaminant. Licensing agreements have been initiated, and a commercial manufacturer for L-Gel will likely be identified in 2002.

L-Gel decontaminant

"The completion of this project is another example of our long and productive collaboration with USAMRIID over the past five years."

Thomas Gutshall
Chairman
Cepheid
(Regarding: Supplying USAMRIID with DNA Test Kits)

ASCI: New Era of Supercomputing

"…the triumph of vision, perseverance, and plain old-fashioned hard work."

Ann Altman
Managing Director
U.S. Federal Government
IBM Corporation

NEW ERA EMERGING FROM COLLABORATION OF DOE LABS, INDUSTRY, AND ACADEMIA

In a supercomputing program designed to break and set world records, the Advanced Simulation and Computing (ASCI) Program reaches out to its partners in the public and private sector. Under the program leadership of the DOE / NNSA, ASCI unites the resources of three national laboratories, the major computer manufacturers, a host of networking, visualization, memory storage, and other vendors, and researchers from top-level universities across the country. A common goal of these partnerships is to develop and deploy advanced computer technologies that can simulate nuclear weapons tests so that NNSA can manage our nation's nuclear weapons stockpile without real underground testing.

THE WORLD'S MOST POWERFUL COMPUTER

On August 15, 2001, LLNL hosted a dedication ceremony for IBM's ASCI White – the world's fastest supercomputer – capable of more than 12 trillion mathematical operations per second (12 teraOPS). ASCI White is 40,000 times more powerful than the average personal computer and can process more operations in one second than a person with a calculator could do in 10 million years.

COMMERCIAL SECTOR AND AMERICAN PUBLIC WILL BENEFIT

ASCI's cost-conscious approach of using off-the-shelf, mass-market components in innovative ways will encourage technology development in the commercial sector.

In addition to meeting ASCI mission milestones, these terascale-computing partnerships between government, industry, and academia will provide a commercial platform for medical simulations, genetic computing, global climate modeling, aerospace and automotive design, financial models, and other domestic applications.

As a further step forward, in November 2001, IBM announced it would collaborate with LLNL to design a new supercomputer called Blue Gene/L. This machine will be at least 15 times faster, 15 times more power efficient, and consume about 50 times less space per computation than today's fastest supercomputers. Blue Gene/L is expected to operate at about 200 teraOPS, which is larger than the total computing power of the top 500 supercomputers in the world today.

ASCI White room

NIF: The World's Most Powerful Laser

The National Ignition Facility (NIF) is a cornerstone of the Stockpile Stewardship Program, our nation's effort to develop the technological basis for maintaining the safety and reliability of our nuclear deterrent without full-scale nuclear testing. It is the largest and most complex project the Laboratory has ever undertaken: a stadium-sized facility will house a 192-beam laser delivering 2 megajoules of ultraviolet light energy to a 33-foot diameter target chamber. NIF will, for the first time, make the fundamental processes of thermonuclear detonation accessible to laboratory study. With over $1 billion in contracts to industrial partners, national laboratories and universities, the project is well underway and scheduled for completion in 2008.

UNPRECEDENTED TECHNOLOGY, SOPHISTICATION AND COLLABORATION

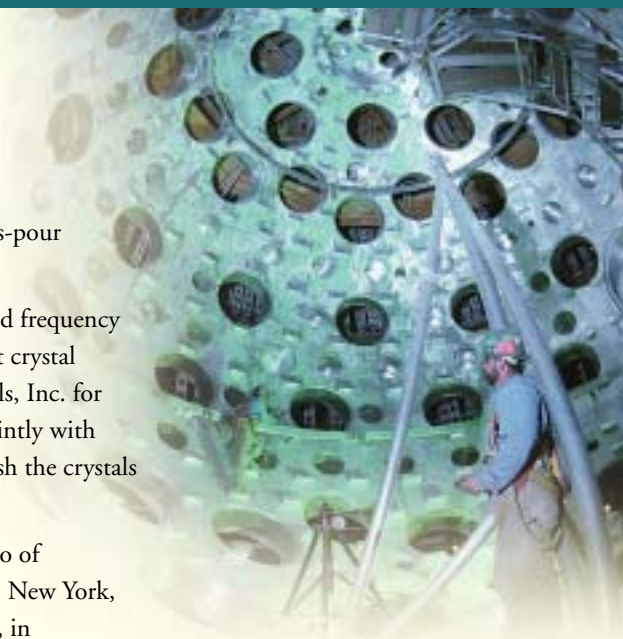
The NIF Project team consists of researchers from DOE and DoD laboratories, industrial partners, and university collaborators. In addition, NIF has collaborated with researchers from the United Kingdom and France. Over the past thirty years, LLNL has developed many of the key enabling technologies that are now being used by our industrial partners for NIF. And many LLNL laser-related technologies have been developed and exploited for commercial use in telecommunications, medical technologies, electro-optical and laser technology, high-speed instrumentation, micro-fabrication, and imaging devices.

Recent results include:

- Two major laser glass suppliers, Schott and Hoya, have worked with NIF researchers to develop new continuous-pour glass production capabilities.
- NIF requires special large crystals for optical switches and frequency conversion in each laser beam. An LLNL-developed fast crystal growth process has been transferred to Cleveland Crystals, Inc. for commercialization. Special machines were developed jointly with Moore Tool in Bridgeport, Connecticut to slice and finish the crystals into optical quality components.
- NIF researchers worked with optics vendors such as Zygo of Middlefield, Connecticut, Eastman Kodak of Rochester, New York, and the Tinsley Division of Silicon Valley Group (SVG), in Richmond, California to develop optics that can withstand the extreme energies produced on NIF. These partnerships have led to several special-purpose computer-controlled machines for producing and characterizing large aperture optics. For example, Tinsley has developed hybrid grinding/shaping tools and small-tool technology for figuring and polishing large optics.
- Astro Pak Corporation of Downey, California, a family-owned, small business, cleans large NIF components to levels of cleanliness exceeding aerospace requirements. Recently, the DOE honored Astro Pak as the *Small Business of the Year*.

NATIONWIDE ECONOMIC IMPACT

Through the $500 million of contracts awarded to date, NIF has created thousands of U.S. jobs. NIF technologies have been developed through an unprecedented collaboration with industrial partners and will be released to industry for industrial applications that will surely result in giant leaps in manufacturing processes, especially in the optics industry. Many of the vendors have built new facilities in California, Ohio, New York, and elsewhere. Although these facilities have been outfitted jointly with LLNL to produce NIF-specific optics, it is expected that they will be exploited for other commercial purposes once the NIF project is finished.



"NIF provides the key both for our nuclear deterrence strategy and for reducing the nuclear threat to future generations."

Ellen Tauscher
Congresswoman

An Impressive Record of New Inventions and Patents

LLNL's prowess as a creative force in science and technology research is best demonstrated by the sheer volume of activity illustrated in the following statistics.

"The best way to have a good idea is to have a lot of ideas."

Linus Pauling
Nobel Laureate

A TREASURE HOUSE OF INVENTIONS

LLNL is an extraordinarily fertile ground for new inventions and stands apart in the world of scientific research. These inventions form the foundation of LLNL's licensing program.

LLNL has a formal and rigorous review process to evaluate each invention before engaging in the long and costly patenting process. Because of resource limitations, unless an invention is found to have a high probability of being awarded a patent and potential for commercialization, the patent application is generally not filed. Nonetheless, 863 U.S. patents have been issued for LLNL inventions since 1990.

RESEARCH FUNDING: GOVERNMENT AND INDUSTRY

LLNL carries out a vibrant set of R&D partnerships with industry. Beginning in the early 1990s, the government, in the form of grants from DOE, funded most of LLNL's portion of Cooperative Research and Development Agreement (CRADA) projects at LLNL. Since 1997, however, private industry has contributed the majority of CRADA funding. LLNL also invests heavily in procurement contracts with private industry to perform research and development activities essential to its programs; in some cases both parties share costs.

DURING THE LAST FIVE YEARS ...

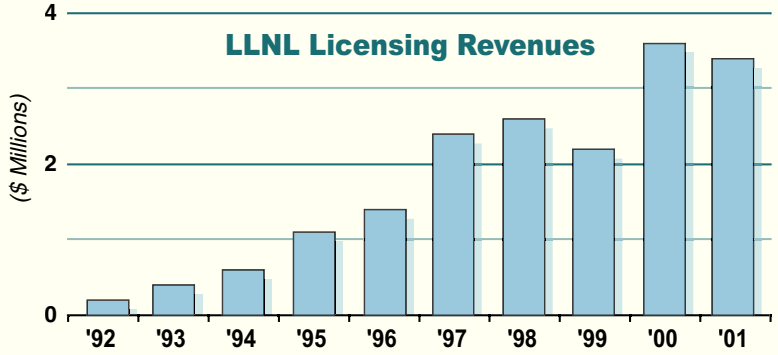
- *885 new inventions disclosed... nearly one every business day*
- *543 U.S. patent applications filed to protect the commercialization potential of the most promising inventions*
- *417 patents granted to LLNL by the U.S. Patent and Trademark Office*

SIGNIFICANT CONTRIBUTIONS

- *$165 million contributed by DOE to LLNL's effort in CRADAs with private industry after the inception of an aggressive program in the early 1990s. Industry devoted a greater or equal amount to their own participation in these collaborations*
- *$157 million contributed by private industry to LLNL's industry sponsored R&D since 1997*
- *$470 million contributed by DOE and NNSA for R&D procurements since 1998. Some of these are cost-shared*

LICENSING ROYALTIES TO LLNL

The licenses negotiated by LLNL generate significant revenues in the form of royalties. These amounted to $17.8 million of revenues to LLNL since 1992, highest among the DOE laboratories. The majority of royalties are fed back into Laboratory programs to support additional research, while a smaller portion rewards the inventors for their creativity.



> *"I feel that the greatest reward for doing is the opportunity to do more."*
>
> Jonas Salk
> *Conqueror of Polio*

OVER 50 COMPANIES STARTED WITH LLNL TECHNOLOGY OR BY LLNL SCIENTISTS

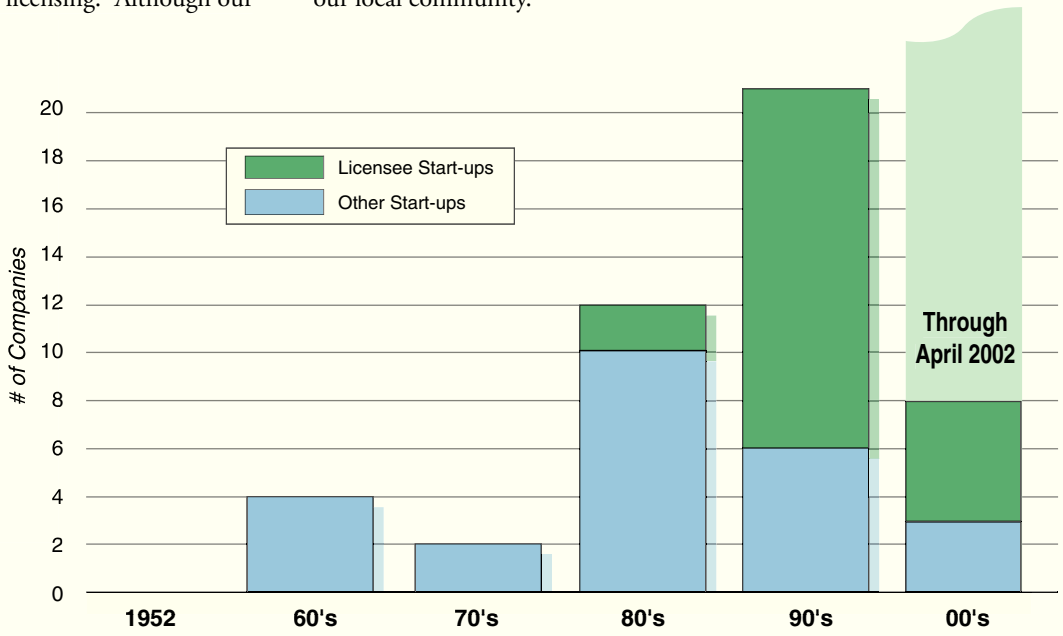
Since 1992, Lab employees and others have founded 24 companies based on inventions or software codes licensed from LLNL. Numerous companies were also started before the beginning of our formal licensing program or simply using advanced know-how developed at the Lab but not appropriate for licensing. Although our statistics are only complete for our licensees, 30 other start-ups have been identified as well, and in all likelihood the number is higher. Thirty-five companies have settled in the geographic area surrounding LLNL and make a sizable contribution to the economic well-being of our local community.

Start-up Companies Emerged from LLNL

54 Start-ups Formed

 # Employees > 1,300

Annual Revenues > $230M



Note: LLNL figure represents number of companies formed. Employee, revenue, and investment figures do not include statistics for start-ups that have undergone a merger, buy-out, or failure. Not all companies formed prior to establishment of LLNL's database may have been identified; the total number may be higher.

Into the Future

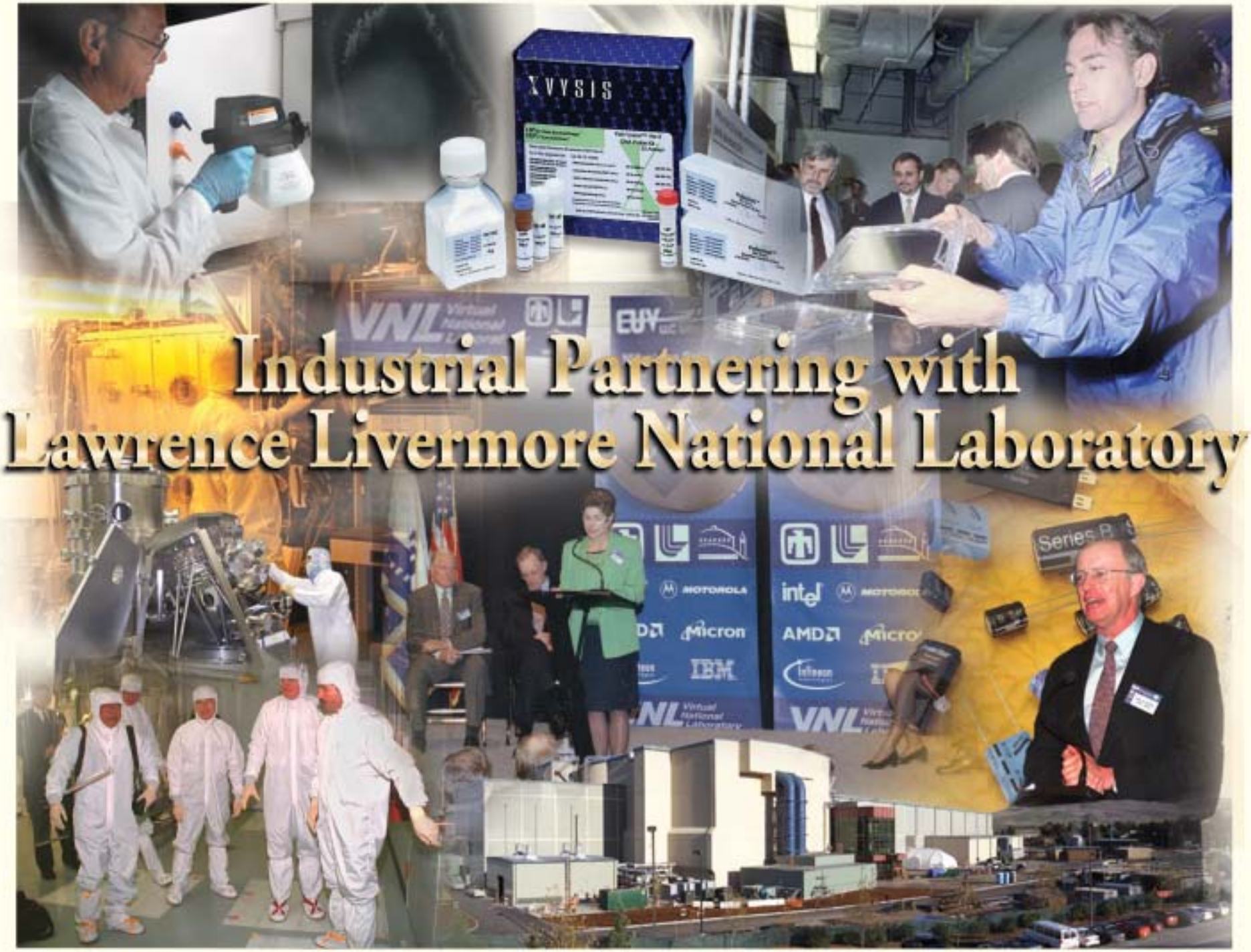
We hope that this report has given you an appreciation of the contribution that LLNL-private sector partnerships have made and will continue to make to our world.

Our historical tour shows the value of LLNL's technologies in influencing the direction of entire industry sectors, stimulating the formation of start-up companies, and making the results of our federal programs available for broad industry use.

Our formal technology transfer program dates back to just before 1990. The partnerships featured in the "Partnering Today" section are among those that are beginning to show marketplace results. But even those are in relatively early stages and will undoubtedly continue to gain strength in the future. For each of the companies highlighted in this report, many others have barely started or are just now on the verge of commercializing products. We look forward to an exciting future of accelerating results.

As the research world becomes increasingly interconnected, and as the amount of R&D conducted in the private sector grows, LLNL's tradition of industry collaborations will continue to expand.

This is a dynamic and exciting time for LLNL's private sector partnerships. We are enthusiastic about the impact of Laboratory-developed technologies as they are commercialized and appear in the marketplace. We take pride in Livermore's creative inventors and authors whose work forms the basis of our partnerships. And, of course, we're proud of the success of our partners and look forward to even greater success in the future.



Industrial Partnering with Lawrence Livermore National Laboratory

- **MECHANISMS FOR PARTNERING**
- **IPAC BUSINESS DEVELOPMENT SPECIALISTS TEAM**

LLNL has business mechanisms for partnering with industry to do cooperative research and development as well as licensing technologies.

PARTNERING TOOL	FEATURES
CRADAs ***C**ooperative **R**esearch **A**nd **D**evelopment **A**greements*	· Establishes partnership between company and LLNL for R&D activities · LLNL's share of costs is generally paid by the industrial partner · Offers possibility of licensing · Requires DOE and LLNL approval
Non-Federal Industrial Work for Others	· Agreement for research work performed by LLNL for industrial partner · Fully funded by industrial partner · No new intellectual property is anticipated · Projects requiring facilities or unique capabilities not available in private sector
Technology Licenses	· LLNL-developed intellectual property rights (e.g., patents, copyrights, etc.) available for commercial manufacture, sale, reproduction, or use · May be Exclusive or Non-exclusive · Requires upfront fee and royalty on sales
Nondisclosure Agreements	· Confidentiality agreement to protect proprietary information · Put in place before in-depth discussions · Requires authorized signatures of both entities

NORMA DUNIPACE - Manager for Partnership Development Group

Responsible for technology licensing and Cooperative Research and Development Agreements (CRADAs). Has been Manager of Partnership Development Group since 1995. Previously was a Licensing Specialist responsible for biology and biotechnology licensing. Has a Bachelors degree in biology and an MBA in marketing. Prior to joining LLNL, spent eighteen years with BDM International (now part of TRW) in a senior management position.

RANDALL ELDER

Responsible for licensing and cooperative research relating to LLNL's physics and laser research. Has many years experience as an engineer working on projects for both industry and the government. Worked for 14 years at ESL/TRW before joining LLNL. Has majors in electrical engineering, physics, and philosophy. Also has a J.D. from Willamette Law School. Member of the Idaho Bar.

CATHERINE ELIZONDO

Responsible for marketing, licensing, and cooperative research and development relating to energy, environmental, and defense technologies. Holds advanced degree in engineering and has over 10 years experience in technology transfer. Spent ten years with DoD and DOE as a Weapons Program Manager.

WILLIAM (BILL) GRANT

Assists LLNL Compliance Group with monitoring product commercialization based on LLNL technologies and assists in licensing of LLNL laser technologies. Was lead for marketing and licensing of LLNL's micropower impulse radar technology. Has Bachelors degree in engineering, J.D., and Masters in tax law. Admitted to practice before the U.S. Supreme Court. Received MBA from Wharton Business School.

PAUL MARTIN

Responsible for licensing and cooperative research relating to inventions from LLNL's Engineering Directorate. Has a J.D. and an M.D. Started his career as an intellectual property lawyer, and in that capacity, has had extensive experience working with CRADAs, WFO agreements, patents, and other mechanisms for the transfer of intellectual property. Worked for 10 years in the Patent Department at the Lawrence Berkeley National Laboratory. For 8 of those years was Patent Counsel.

ANNEMARIE MEIKE

Responsible for technology transfer of chemical and nonproliferation technologies. Has 12 years of experience developing and managing scientific programs at LLNL. Has a Ph.D. from UC Berkeley in geology. Received a Senior Fulbright Fellowship to investigate transformational plasticity in nonmetals at Australian National University. Currently working toward a J.D. from Santa Clara University, School of Law.

LEAH ROGERS

Responsible for licensing and collaborative research relating to LLNL's computational technologies. Previously, Leah worked many years researching optimal groundwater cleanup using subsurface transport modeling, neural networks, and genetic algorithms. She received her Ph.D. in earth sciences from Stanford in 1992.

RUPERT XU

Responsible for marketing, licensing, and cooperative research and development for LLNL biotechnical and biomedical intellectual properties. Has Ph.D. from UC Davis in nutrition and did post-doctoral research at UC Davis, studying the effects of dietary lipids on atherosclerosis. Recently graduated from Santa Clara University, School of Law with a J.D. Member of California Bar.

University of California
Industrial Partnerships and Commercialization
Lawrence Livermore National Laboratory
P.O. Box 808 L-795
Livermore, California 94551